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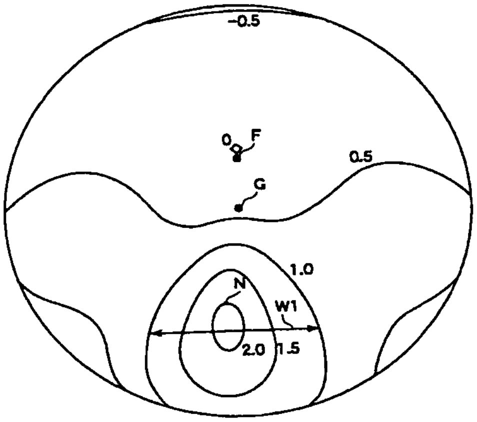
(54) GRADIENT-INDEX MULTIFOCAL LENS

(57) A gradient-index multifocal lens belonging to a group designed onthe basis of predetermined rules so that basic factors of gradient-index multifocal lenses, such as a far focal measurement position F and a near-focal measurement position N, can be adapted to lenses for eyeglasses. Suppose that surface refractive power (in diopters) at the measurement position F is a base curve (Bi), that the difference in the surface refracting power between the measurement position F and the measurement position N is Pi (in diopters), and that the width of a region is W(Di, Bi), where the value of surface mean additional refracting power along a sectional curve in a horizontal direction passing below the measurement position N is at least Di/2. When any two gradient-index multifocal lenses of Di=Da and Bi=B1, B2 are extracted from the group of the multifocal lenses, they satisfy the relation W(Da,B1)> W(Da, B2) when B1 > B2. Accordingly, a gradient-index multifocal lens with a wide field by view desirable to users of eyeglasses is provided without increasing the time and cost of prescription production.

FIG.20



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Publication No. sho 47-23943/1972 Official Gazette and Japanese Patent National Publication No. hei 4-500870/1992 Official Gazette refers only to the astigmatism occurring on the principal fixation line. From the viewpoint of providing an eyeglass wearer with a good "broad field of view" only by regulating astigmatism occurring on a single line, the lenses disclosed in these Official Gazettes are incompetent as a progressive power multifocal lens.

Further, Japanese Patent Unexamined Publication No. hei 6-18823/1994 Official Gazette discloses a lens that has a first surface (namely, the front surface) formed as a "progressive power surface" and a second surface (namely, the back surface) by which all of the inconveniences of the distribution of optical conditions of the lens in the case of using "transmitted light" are obviated. The second surface (namely, the back surface) of this lens is disclosed therein merely as an "aspherical surface without point symmetry and axial symmetry". Moreover, no practical calculation method is disclosed therein.

Furthermore, no practical method for changing a parameter concerning the optical conditions of the lens in the case of using "transmitted light" is also disclosed therein. Especially, note that both of the improvement of the transmission average refractive power and the obviation of the transmission astigmatism cannot always be achieved at the same time. As a consequence, an attempt to achieve the balance between the transmission average refractive power and the transmission astigmatism should be made. Methods for achieving the balance therebetween are inherent in the inventions disclosed therein but are not referred to therein at all.

Incidentally, in the case where the second surface (namely, the back surface), which is a prescribed surface, is an aspherical surface, it is obvious that the time and cost required to produce a lens would increase owing to the aspherical surface processing. Further, because this aspherical surface is an aspherical one, the lens has to be produced after a reception of an order. Namely, a method of preliminarily receiving an order cannot be employed. Therefore, in addition to the time and cost required to produce a lens, delivery time after reception of prescribed values is disadvantageous to this method, in comparison with the currently-used method which has previously been described.

The present invention is accomplished in view of such circumstances to aim at providing a progressive power multifocal lens, by which an eyeglass wearer can obtain a substantially good "broad field of view", without increasing time and cost required to produce a prescribed surface thereof.

Disclosure of the Invention

To solve the foregoing problem, in accordance with the present invention, there is provided a progressive power multifocal lens that belongs to a group of progressive power multifocal lenses designed under a certain rule in such a manner that fundamental elements such as a far vision power measuring position F and a near vision power measuring position N of a progressive power multifocal lens meet a common wearing object.

In the case of this lens, a surface refractive power (in units of diopters) at the far vision power measuring position F is employed as a base curve (Bi). Further, a difference in surface refractive power between the far vision power measuring position F and the near vision power measuring position N is employed as an addition Di (in units of diopters). Furthermore, let W(Di, Bi) denote a width of a region in which values of a surface average additional refractive power along a horizontal section line extending below the near vision power measuring position N are not less than Di/2.

In such a case, when arbitrary two progressive power multifocal lenses, whose additions are Da and base curves are B1 and B2, respectively, are selected from the group of the progressive power multifocal lenses, the following relation holds for B1 > B2:

$$W(Da, B1) > W(Da, B2).$$

Moreover, preferably, in the case of an embodiment of the hereinabove-mentioned progressive power multifocal lens of the present invention, when a single curve passing through at least both of the far vision power measuring position F and the near vision power measuring position N is employed as a principal fixation line, a horizontal deviation H of an arbitrary point P on the principal fixation line towards the nose of a wearer with respect to the far vision power measuring position F is given by:

$$H = K \cdot Dp / Di$$

(incidentally, K is an arbitrary constant meeting the following inequality $1.0 \leq K \leq 5.0$; Dp the additional surface refractive power at the point P; and Di an addition).

Furthermore, preferably, in the case of an embodiment of any of the aforementioned progressive power multifocal lenses of the present invention, a change in optical conditions along a horizontal section curve intersecting with the principal fixation line at an arbitrary point P occurs in such a manner that, in a portion where the principal fixation line is not horizontally deviated from the horizontal location of the far vision power measuring position F, the optical conditions are symmetric with respect to a plane which contains the point P and is perpendicular to the section curve and serves as a plane of mirror symmetry and that in another portion where the principal fixation line is horizontally deviated to the nose of a wearer from the horizontal location of the far vision power measuring position F, the change in the optical conditions along a horizontal section curve extending from the point P to the nose thereof is larger than the change in the optical conditions along another lenses have been evaluated by representing optical information on the lens surface in the form of a distribution diagram, and then discussing whether or not the distribution represented by the distribution diagram is suitable for an eyeglass wearer.

However, light actually reaching an eye of the eyeglass wearer is "transmitted light" that has been transmitted and refracted by a spectacle lens. Therefore, no matter how superior the "diagram for illustrating the optical information distribution on the surface of a lens" is, this does not make sense if a "diagram for illustrating the optical information distribution in the case of using light transmitted by the lens" is not superior. Namely, matters of importance are not the "surface average refractive power distribution" and the "surface astigmatism distribution" but a "transmission average refractive power distribution" and a "transmission astigmatism distribution". There is an approach to obtaining "diagrams for illustrating these optical information distributions in the case of using transmitted light" by actually measuring or observing these distributions. Judging from the viewpoint of the feedback of such information to a lens design, this approach is impractical. Consequently, in accordance with the present invention, the "diagrams for illustrating the optical information distributions in the case of using transmitted light" are drawn by obtaining whole data by calculation.

As to parameters necessary for this calculation, all factors respectively determining the shape of spectacle lenses and the positional relation between each of the eyeballs of an eyeglass wearer and an object are needed, in addition to the refractive index of the material of the lens.

As shown in FIG. 22, actual lenses, however, are fitted into an eyeglass frame. Further, the eyeglass lenses are worn by a wearer in such a manner that each of the lenses is at a distance of about 12 to 15 mm or so forwardly away from the corresponding eye of the wearer and is bent forwardly from the vertical direction at an angle of 5 to 10 degrees or so (in the case of FIG. 22, 7 degrees are employed as such an angle). Actually, the aforementioned factors are an angle formed between a visual line and each of the two surfaces of the lens, the thickness of the lens at a place where each of the surfaces of the lens intersects with the visual line, the refractive powers respectively corresponding to the two surfaces of the lens, the vertex distance from the vertex of the cornea of each eye of the wearer to the lens (incidentally, in the case of FIG. 22, 12 mm is employed as this distance), the distance from the vertex of the cornea to the center of rotation of each eyeball (incidentally, in the case of FIG. 22, 13 mm is employed as this distance), the distance from the lens to the object, prismatic thinning correction data (incidentally, in the case of FIG. 22, the prism power is brought down by 1 prism diopter) and so forth.

Further, the optical information in the case of using the transmitted light depends on what an eyeglass wearer views, namely, depends on the "object distance". Thus, it is also necessary to obtain the "object distance". Incidentally, the "object distance" does not depend on the far vision power and the addition, which correspond to the eyeglass wearer. Namely, the term "a long-distance place", which the eyeglass wearer views, usually designates a place at an infinite distance from the wearer. Furthermore, the term "short-distance place" designates a place at an ordinary "reading distance", namely, a distance ranging from 30 to 33 cm or so. Moreover, although there is no general criterion for defining the "object distance" in visual field regions other than long-distance and short-distance places, the "object distance" in the case of such visual field regions can be calculated in a proportional distribution manner from the addition of progressive power multifocal lenses worn by the eyeglass wearer and from the surface average additional refractive power distributions thereof on the assumption that the surface average power distributions of the progressive power multifocal lenses worn by the eyeglass wearer are correct, namely, serve the purpose of wearing these eyeglass lenses.

To obtain the "object distance", first, the reciprocal P_X (hereunder sometimes referred to as the "objective power" (in units of diopters)) of the "object distance" is found. Namely, let Pi, Pn and SDi denote the basic addition (in units of diopters) of the progressive power multifocal lens, the reciprocal of the short-distance (in units of diopters) to be given and the surface average additional refractive power (in units of diopters) of the lens at a place corresponding to the "objective power" to be obtained, respectively. Thus, the "objective power" P_X is obtained by

$$P_X = Pn \times SDi / Di$$

For example, when the basic addition of the progressive power multifocal lens is 2.00 diopters; the reciprocal of the short-distance to be given 3.00 diopters (corresponding to 33 cm); and the surface average additional refractive power of the lens at a place corresponding to the "objective power" to be obtained is 1.50 diopters, respectively, the "objective power" P_X is obtained as follows:

$$P_X = 3.00 \times 1.50 / 2.00 = 2.25 \text{ diopters.}$$

This "objective power" is equivalent to the "object distance" of about 44.4 cm.

A comparison between the "diagrams for illustrating the optical information distributions in the case of using transmitted light", which is obtained as a result of performing a calculation by using these parameters, and the "diagram for illustrating the optical information distribution on the surface" of the progressive power multifocal lens, on which the calculation is based, reveals the following matters.

In the case of the "distribution of the transmission viewed is placed in front of the wearer, it is enough for such improvement of the progressive power multifocal lenses to take only the placement of the aforementioned principal fixation line and the distribution of the surface refractive power into consideration.

However, when the object to be viewed moves to the side of the wearer, the visual line of one of his or her eyes moves to his or her ear, whereas that of the other eye moves to his or her nose. Thus, the lenses, through which the visual lines of his or her left and right eyes pass, respectively, are not always in the same optical conditions.

If the object to be viewed is in the infinite distance from the wearer, the deviation angles of the visual lines of his or her left and right eyes at the time of changing the viewing condition from the front viewing condition to the side viewing condition are equal to each other. It is, therefore, preferable that the optical conditions on the lenses are symmetric with respect to a plane which contains the aforementioned principal fixation line and is perpendicular to, for example, to the horizontal direction and serves as a plane of mirror symmetry (incidentally, this distribution of the optical characteristic quantity on two lateral halves of the lens is not simply symmetric with the principal fixation line but is symmetrical with respect to the plane of mirror symmetry as seen by putting a mirror on the principal fixation line including the arbitrary point P (additionally, the reason for employing such a symmetric distribution is that the aforementioned "optical conditions" include directional properties such as a change in the direction of what is called the axis of the astigmatism).

In contrast, if the object to be viewed is in the finite distance from the wearer, the visual lines of his or her left and right eyes go nearer to his or her nose by the convergence action of his or her eyes, respectively. When changing the viewing condition from the front viewing condition to the side viewing condition during his or her eyes are in this state, the deviation angles of the visual lines of his or her left and right eyes are equal to each other if the distance between the object and the wearer is invariant. However, as can be readily understood by considering, for example, the case where the object is in the immediate vicinity of the wearer, the distance therebetween usually increases when changing the viewing condition from the front viewing condition to the side viewing condition. As a result, the convergence action of his or her eyes becomes weak and the visual lines of his or her eyes become nearly parallel.

Thus, if the object to be viewed is in the finite distance from the wearer, the deviation angles of the visual lines of his or her left and right eyes are different from each other upon changing the viewing condition from the front viewing condition to the side viewing condition. Namely, the angular deviation of the visual line moving to his or her ear is larger than that of the visual line moving to his or her nose. In the case of the spectacle lenses turning together with the head of a wearer, this tendency is further enhanced owing to the turn of his or her head in the side viewing condition (incidentally, the head turns nearly a half of an angle required to change the viewing condition from the front viewing condition to the side viewing condition and moreover, his or her eyeballs turn by the remaining part of such an angle), and thus this tendency becomes noticeable. Consequently, it is preferable for viewing an object placed in the finite distance from a wearer that the optical conditions on a portion, in which the corresponding part of the principal fixation line is deviated toward his or her nose with respect to the aforementioned position F, of each lens are laterally asymmetric with a plane, which includes an arbitrary point on the principal fixation line, in the horizontal direction.

In the case of the progressive power multifocal lenses, the distributions of the optical conditions in the horizontal direction of an arbitrary point on the principal fixation line thereof changes usually. It is, therefore, preferable for realizing same optical conditions on the two lateral half parts of the lens, through which the visual line passes, the change in the optical conditions along a horizontal section curve extending from the arbitrary point P to the nose thereof is larger than that in the optical conditions along another horizontal section curve extending from the point P to an ear thereof.

In summary, it is preferable that, in a portion where the principal fixation line is not horizontally deviated with respect to the horizontal location of the far vision power measuring position F, a change in at least one of optical conditions, namely, at least one of a change in the astigmatism along the horizontally sectional curve intersecting with the principal fixation line at an arbitrary point P on the principal fixation line, a change in the direction of what is called the axis of the astigmatism, a change in the average power thereof, a change in the horizontal component of the prism diopter or refractive power thereof and the vertical component of the prism diopter thereof occurs symmetrically with respect to a plane which includes the point P and is perpendicular to the sectional curve and serves as a plane of mirror symmetry. Moreover, it is desirable that, in another portion where the principal fixation line is horizontally deviated to the nose of a wearer from the horizontal location of the far vision power measuring position F, the change in the optical conditions along a horizontal section curve extending from the point P to the nose thereof is larger than that in the optical conditions along another horizontal section curve extending from the point P to an ear thereof.

Furthermore, in view of the fact that progressive power lenses having large additions (Di) become necessary with advancing age, the countermeasures against problems occurring in the case of large additions (Di) are studied in order to make the progressive power multifocal lens of the present invention more convenient to use.

Namely, those who wear spectacle lenses having ment 2 of the present invention; FIG. 11 is a diagram for illustrating the transmission average power distribution in the case of the basic design lens corresponding to Embodiment 2 of the present invention; FIG. 12 is a diagram for illustrating the surface average power distribution in the case of a progressive power multifocal lens according to Embodiment 2 of the present invention; FIG. 13 is a diagram for illustrating the transmission average power distribution in the case of the progressive power multifocal lens according to Embodiment 2 of the present invention; FIG. 14 is a diagram for illustrating the surface astigmatism distribution in the case of the basic design lens corresponding to Embodiment 2 of the present invention; FIG. 15 is a diagram for illustrating the transmission astigmatism distribution in the case of the basic design lens corresponding to Embodiment 2 of the present invention; FIG. 16 is a diagram for illustrating the surface astigmatism distribution in the case of the progressive power multifocal lens according to Embodiment 2 of the present invention; FIG. 17 is a diagram for illustrating the transmission astigmatism distribution in the case of the progressive power multifocal lens according to Embodiment 2 of the present invention; FIG. 18 is a diagram for illustrating the surface astigmatism distribution in the case of a progressive power multifocal lens according to another embodiment of the present invention; FIG. 19 is a diagram for illustrating the surface astigmatism distribution in the case of a progressive power multifocal lens according to still another embodiment of the present invention; FIG. 20 is a diagram for indicating the width W1 of a region, in which values of a surface average additional refractive power along a horizontal section line extending below the near vision power measuring position N are not less than Di/2, in the diagram illustrating the surface average power distribution of the progressive power multifocal lens according to Embodiment 1 of FIG. 4; FIG. 21 is a diagram for indicating the width W2 of a region, in which values of a surface average additional refractive power along a horizontal section line extending below the near vision power measuring position N are not less than Di/2, in the diagram illustrating the surface average power distribution of the progressive power multifocal lens according to Embodiment 2 of FIG. 12; FIG. 22 is a diagram for illustrating the positional relation between a spectacle lens and an eyeball; and FIG. 23 is a table for showing the tendencies of the transmission distributions relative to the surface distributions.

Best Mode for Carrying Out the Invention

(Embodiment 1)

FIG. 1 illustrates a front view of a progressive power multifocal lens 1 (which is 70 mm in diameter) for the left eye of an eyeglass wearer, according to Embodiment 1 of the present invention.

As shown in FIG. 1, in the case of the progressive power multifocal lens 1 of this embodiment, a far vision power measuring position F is located at a place which is 8 mm upwardly away from the geometric center G thereof. Further, a near vision power measuring position N is disposed at a place which is deviated downwardly from this geometric center G by a distance of 16 mm and also deviated therefrom laterally towards the nose of a wearer by a distance of 2.5 mm. Moreover, a position E, through which a visual line of the eyeglass wearer passes when his or her eyes are in a frontal vision condition, is located at a place which is 2 mm upwardly away from the geometric center G.

Incidentally, in the case of this embodiment, the refractive power in the case of using the far vision is S-5.50 diopters; the addition (ADD) +2.00 diopters; and an employed base curve 2 diopters. Further, diethylene-glycol-bisallyl-carbonate is employed as the material of the lens, and the refractive index thereof nd = 1.499.

FIG. 4 is a diagram for illustrating the surface average power distribution in the case of a progressive power multifocal lens according to Embodiment 1 of the present invention. FIG. 8 is a diagram for illustrating the surface astigmatism distribution in the case of the progressive power multifocal lens according to Embodiment 1 of the present invention.

The progressive power multifocal lens having such distributions is designed as follows.

Namely, first, optical information on the lens surface is represented in distribution-diagram form by using conventional techniques. Then, it is studied whether or not such distributions are best suited to the eyeglass wearer. A lens having optimum "surface average power distribution" and "surface astigmatism distribution" is obtained on the basis of a result of the study as a basic design lens.

FIG. 2 is a diagram for illustrating the surface average power distribution in the case of the basic design lens corresponding to Embodiment 1 of the present invention. FIG. 6 is a diagram for illustrating the surface astigmatism distribution in the case of the basic design lens corresponding to Embodiment 1 of the present invention. Incidentally, in the diagram of FIG. 2 for illustrating the average power, contour lines are respectively drawn correspondingly to the values of the average power, which are determined at intervals of 0.5 diopters. Further, in the diagram of FIG. 6 for illustrating the astigmatism, contour lines are respectively drawn correspondingly to the values of the astigmatism, which are determined at intervals of 0.5 diopters. These contour lines are drawn in common in each of distribution diagrams that will be described hereinbelow.

Next, the "transmission average power distribution" and the "transmission astigmatism distribution" of the basic design lens are obtained by calculation from the surface average power distribution and the surface astigmatism distribution, which are obtained in this way. Actually, this calculation is performed by running a simdesign lens, similarly as of Embodiment 1 of the present invention.

FIG. 10 is a diagram for illustrating the surface average power distribution in the case of the basic design lens corresponding to Embodiment 2 of the present invention. FIG. 11 is a diagram for illustrating the transmission average power distribution in the case of the basic design lens corresponding to Embodiment 2 of the present invention. FIG. 14 is a diagram for illustrating the surface astigmatism distribution in the case of the basic design lens corresponding to Embodiment 2 of the present invention. FIG. 15 is a diagram for illustrating the transmission astigmatism distribution in the case of the basic design lens corresponding to Embodiment 2 of the present invention.

In contrast with this, FIG. 13 is a diagram for illustrating the transmission average power distribution in the case of Embodiment 2 of the present invention. FIG. 17 is a diagram for illustrating the transmission astigmatism distribution in the case of Embodiment 2 of the present invention.

As is obvious from the comparisons among these figures, regarding the power distribution, the average power in the case of the transmission average power distribution of Embodiment 2 (especially, the average power in the near vision portion) increases, in comparison with the case of the transmission average power distribution of the basic design lens. Thus, the transmission average power distribution of Embodiment 2 becomes close to the corresponding target distribution, namely, the surface average power distribution of the target basic design lens of FIG. 10, and is, therefore, improved. Further, regarding the astigmatism distribution, the aberration in the case of the transmission astigmatism distribution of Embodiment 2, especially, the astigmatism in the far vision portion decreases in comparison with the case of the transmission astigmatism distribution of the basic design lens. It is, thus, found that the transmission astigmatism distribution of Embodiment 2 becomes close to the corresponding target distribution, namely, the surface astigmatism distribution of the basic design lens of FIG. 14, and is, therefore, improved.

(Embodiment 3)

FIGS. 18 and 19 are diagrams respectively illustrating the surface astigmatism distributions in the cases of progressive power multifocal lenses according to other embodiments of the present invention. Incidentally, these embodiments employ the same design techniques as employed in Embodiment 1 and Embodiment 2. Thus the description of the common parts is omitted for simplicity of description.

The embodiments of FIGS. 18 and 19 are different from Embodiment 1 and Embodiment 2 in that the embodiments of FIGS. 18 and 19 are lenses having the far vision power of 0.00 diopter and that the addition (ADD) of the embodiment of FIG. 18 is +2.00 diopters, and the addition (ADD) of the embodiment of FIG. 19 is +1.00 diopter, and an example of the distribution illustrated in FIG. 18 is shown by using contour lines respectively drawn correspondingly to the values of the astigmatism, which are determined at intervals of 0.25 diopters, and an example of the distribution illustrated in FIG. 19 is shown by using contour lines respectively drawn correspondingly to the values of the astigmatism, which are determined at intervals of 0.125 diopters. The placement of positions F, E and N described in FIGS. 18 and 19 is the same as in the cases of Embodiment 1 and Embodiment 2. Further, a single curve (represented by a dashed line) extending in a nearly central portion of each of FIGS. 18 and 19 in a longitudinal direction thereof as viewed in each of these figures is a principal fixation line and passes through the three positions F, E and N.

Further, in a region (illustrated as being laying above the position F in each of these figures) in which the principal fixation line is not deviated in the horizontal direction from the far vision power measuring position F, the spacing between the contour lines is horizontally symmetric with respect to a plane of mirror symmetry. Moreover, in another region (illustrated as being laying lower or below the position F in each of these figures) in which the principal fixation line is deviated to the nose of a wearer from the position F, the contour lines are dense in the "nose-side part (namely, the right-side part as viewed in each of these figures)" but are sparse in the "ear-side part (namely, the left-side part as viewed therein)". Thus, the change in the astigmatism along the part extending from the principal fixation line to the nose of the wearer is larger than the change in the astigmatism along the part extending from the principal fixation line to the ear thereof. This feature holds true not only for the astigmatism, but also for the direction of what is called the axis of the astigmatic of the lens, the average refractive power thereof, the horizontal component of the prism refractive power thereof and the vertical component of the prism diopter thereof.

Here, in the case of the progressive power multifocal lens, which has the same base curve and the addition of Di diopters, let W(Di, X) mm represent a width of a region in which the values of astigmatism along the horizontal section curve passing through the near vision power measuring position N are not more than X.

In this case, when arbitrary two progressive power multifocal lenses, whose additions are Da and Db diopters, respectively, and base curves are the same with each other, are selected from the group of the progressive power multifocal lenses, the following relation holds for the addition Da > Db:

$$W(Da, X) > W(Db, X \cdot Db/Da)$$

(incidentally, X = 1.00 diopter). In connection with this relation, the widths W in the cases of the progressive

Industrial Applicability

The present invention relates to a progressive power multifocal lens, which is a kind of spectacle lenses, and which has a zone designated as "a far vision viewing portion" for viewing long-distance places, another zone as "an intermediate vision" viewing portion for viewing middle-distance places and still another zone designated as "a near vision" for viewing short-distance places. More particularly, the present invention provides a progressive power multifocal lens for presbyopia, by which an eyeglass wearer can obtain a substantially good "broad field of view", without increasing time and cost required to produce a prescribed surface thereof.

Claims

1. A progressive power multifocal lens having fundamental elements, which include a far vision power measuring position F and a near vision power measuring position N, and belonging to a group of progressive power multifocal lenses designed under a predetermined rule in such a manner that the fundamental elements meet a common wearing purpose,

   wherein a surface refractive power (in units of diopters) at the far vision power measuring position F is employed as a base curve (Bi), wherein a difference in surface refractive power between the far vision power measuring position F and the near vision power measuring position N is employed as an addition Di (in units of diopters),

   wherein when arbitrary two progressive power multifocal lenses, whose additions are Da and base curves are B1 and B2, respectively, are selected from the group of the progressive power multifocal lenses, the following relation holds for B1 > B2:

   $$W(Da, B1) > W(Da, B2)$$

   where W(Da, Bi) is a width of a region in which values of a surface average additional refractive power along a horizontal section line extending below the near vision power measuring position N are not less than Di/2.

2. The progressive power multifocal lens according to claim 1, wherein when a single curve passing through at least both of the far vision power measuring position F and the near vision power measuring position N is employed as a principal fixation line, a horizontal deviation H of an arbitrary point P on the principal fixation line towards the nose of a wearer with respect to the far vision power measuring position F is given by:

   $$H = K \cdot Dp / Di$$

   (incidentally, K is an arbitrary constant meeting an inequality $1.0 \leq K \leq 5.0$; Dp the additional surface refractive power at the arbitrary point P; and Di an addition).

3. The progressive power multifocal lens according to claim 1 or 2, wherein a change in optical conditions along a horizontal section curve intersecting with the principal fixation line at an arbitrary point P occurs in such a manner that in a portion where the principal fixation line is not horizontally deviated from the horizontal location of the far vision power measuring position F, the optical conditions are symmetric with respect to a plane which contains the arbitrary point P and is perpendicular to the section curve and serves as a plane of mirror symmetry and that in another portion where the principal fixation line is horizontally deviated to a nose of a wearer from the horizontal location of the far vision power measuring position F, the change in the optical conditions along a horizontal section curve extending from the arbitrary point P to the nose thereof is larger than the change in the optical conditions along another horizontal section curve extending from the arbitrary point P to an ear thereof.

4. The progressive power multifocal lens according to one of claims 1 to 3, wherein the addition (Di) has a value ranging from 0.75 diopters to 3.00 diopters, wherein when arbitrary two progressive power multifocal lenses, which have same base curve Bi and have additions are Da and Db, respectively, are selected from the group of the progressive power multifocal lenses, the following relation holds for the addition Da > Db:

   $$W(Da, X) > W(Db, X \cdot Db/Da)$$

   (incidentally, X = 1.00 diopter)
   where W(Di, X) mm represents a width of a region in which values of astigmatism along the horizontal section curve passing through the near vision power measuring position N are not more than X.

5. The progressive power multifocal lens according to one of claims 1 to 4, wherein an arbitrary point P on a part of the principal fixation line, which is other than the far vision power measuring position F and the near vision power measuring position N, has two different principal curvatures.

FIG.2

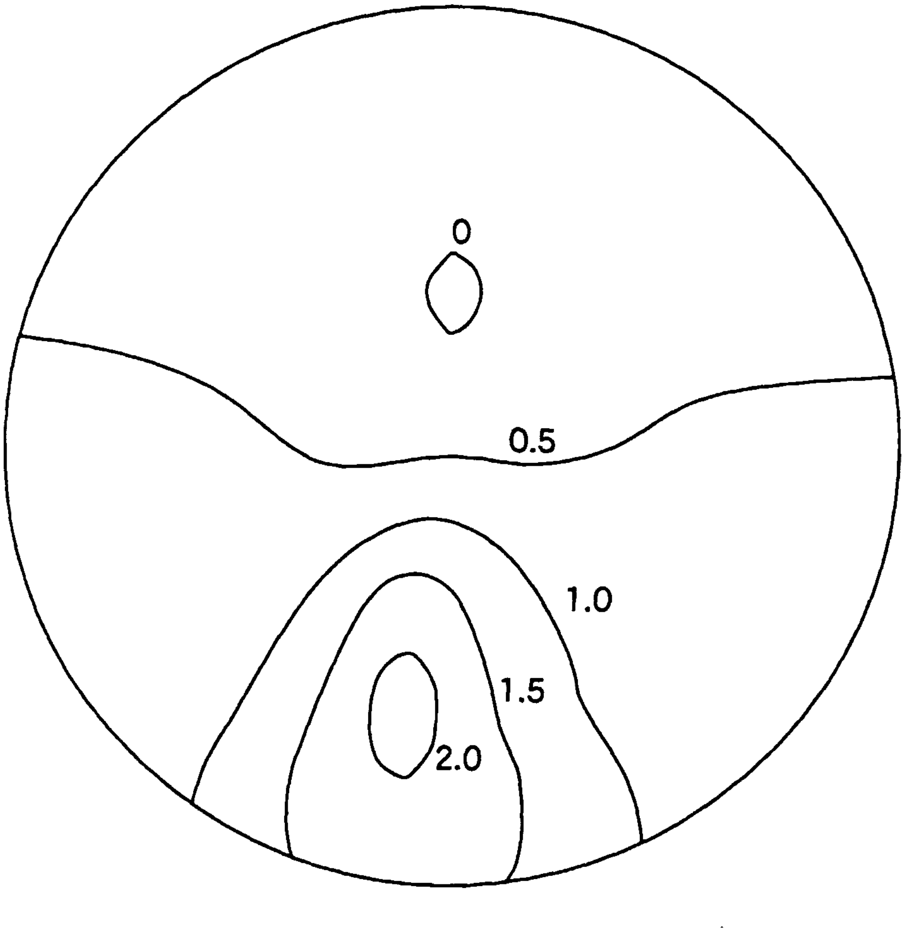


FIG.4

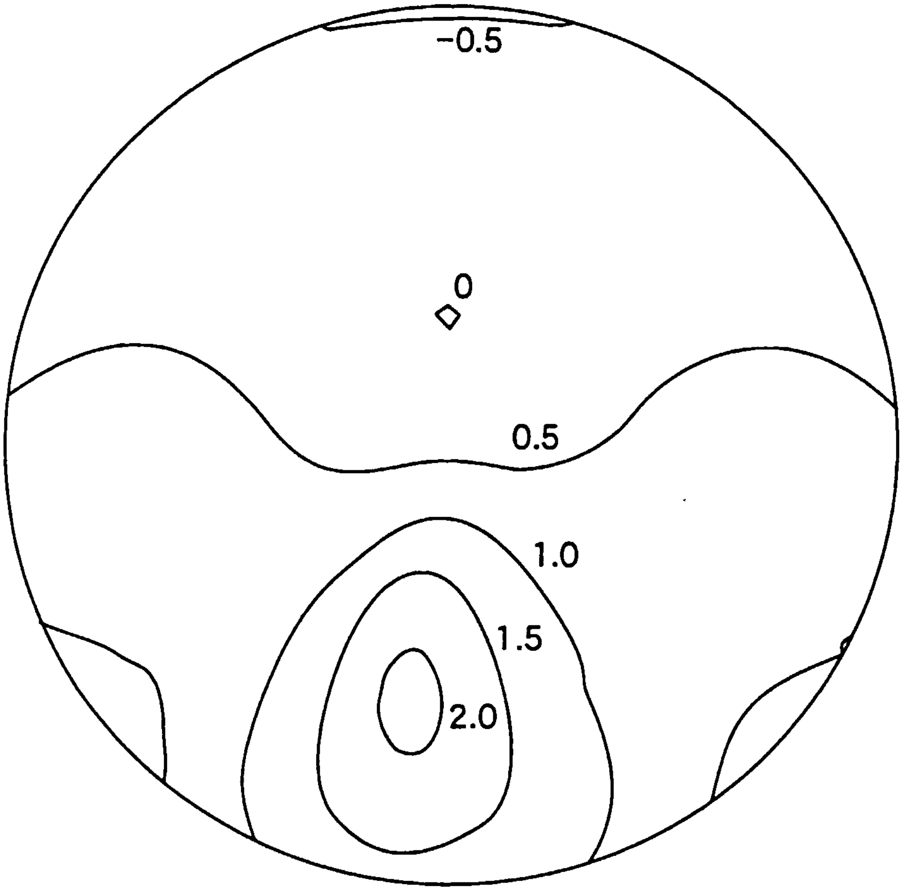


FIG.6

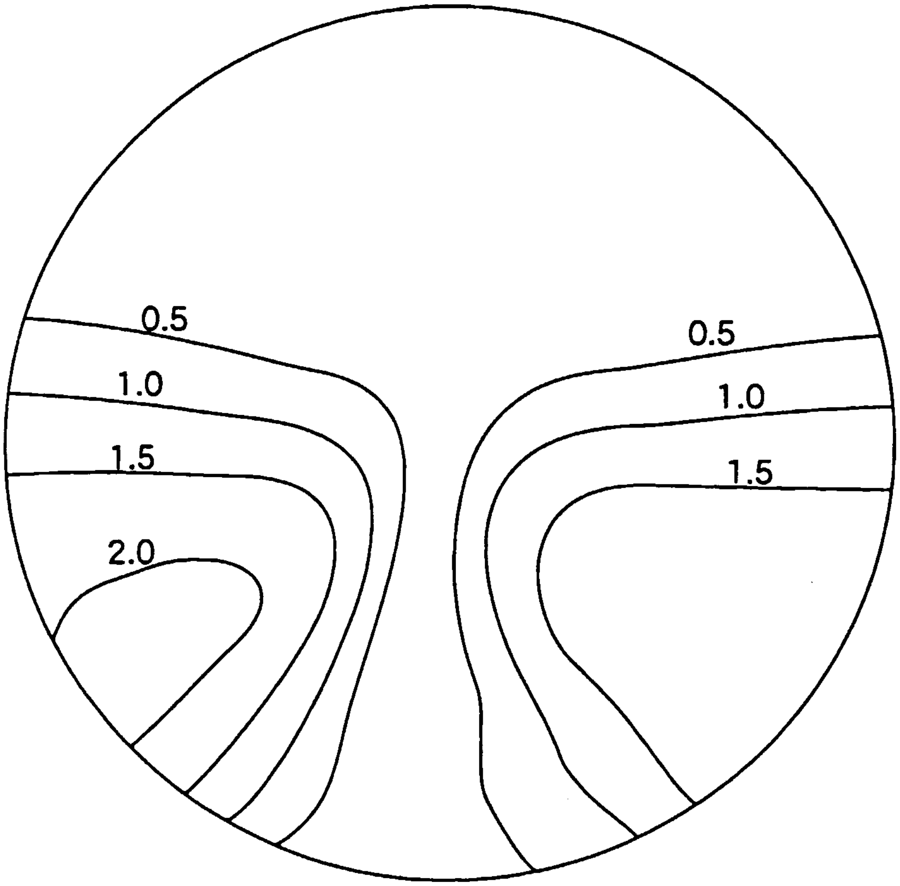


FIG.8

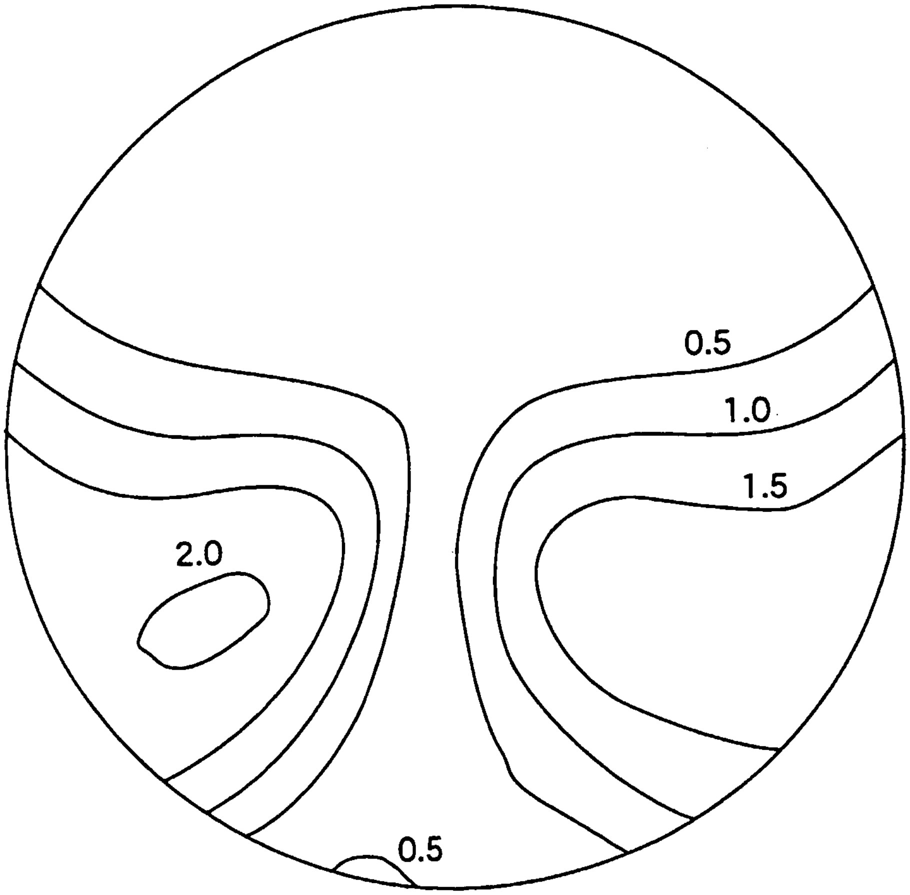


FIG.10

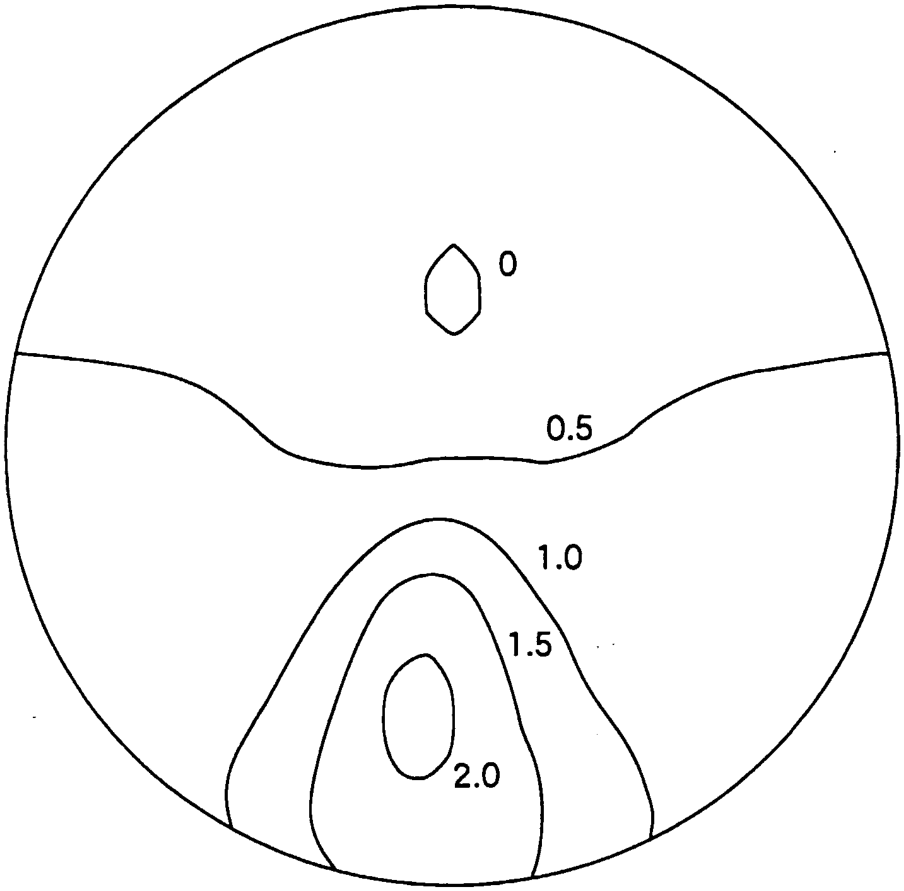


FIG.12

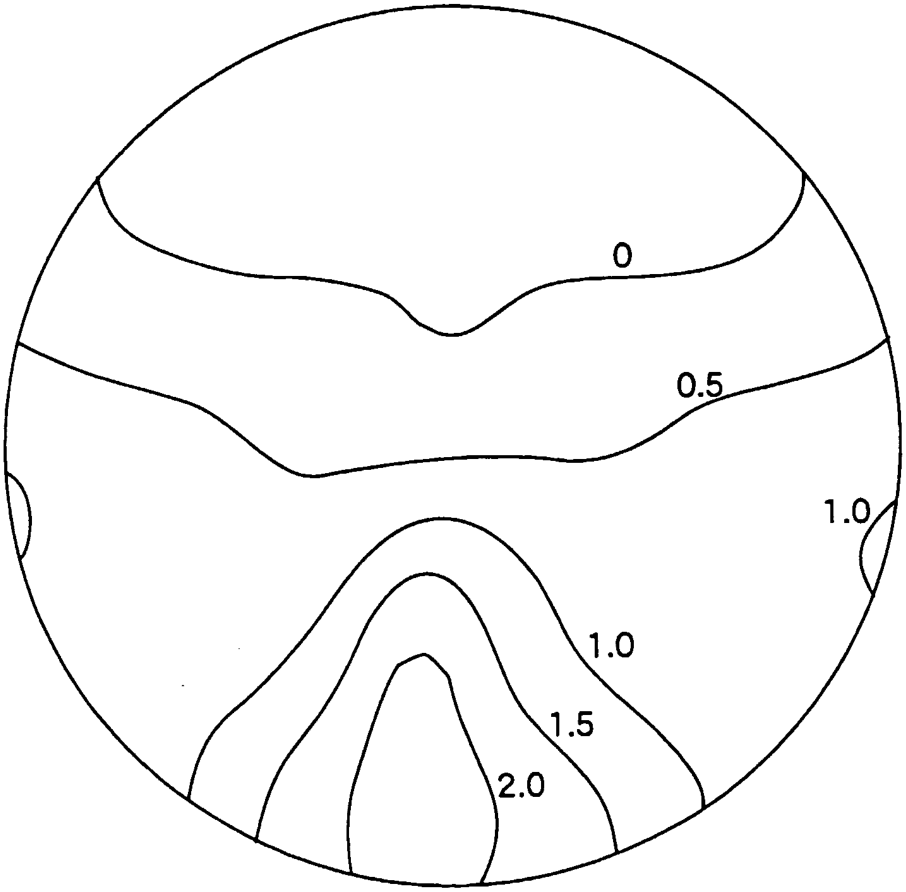


FIG.14

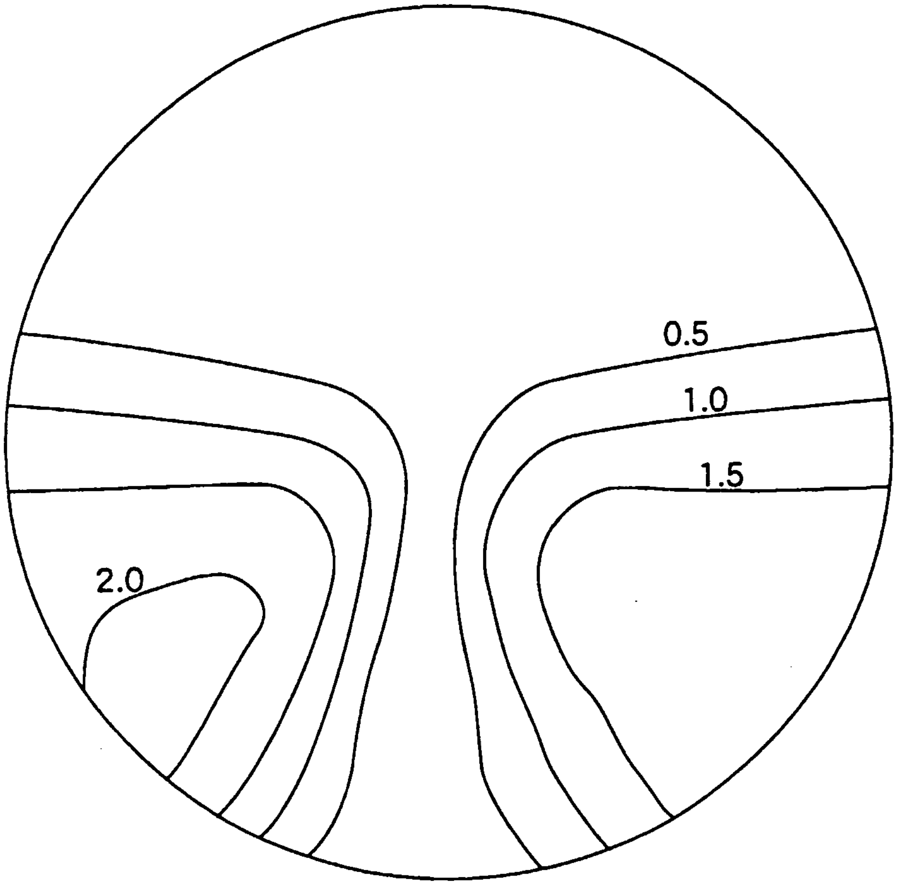


FIG.16

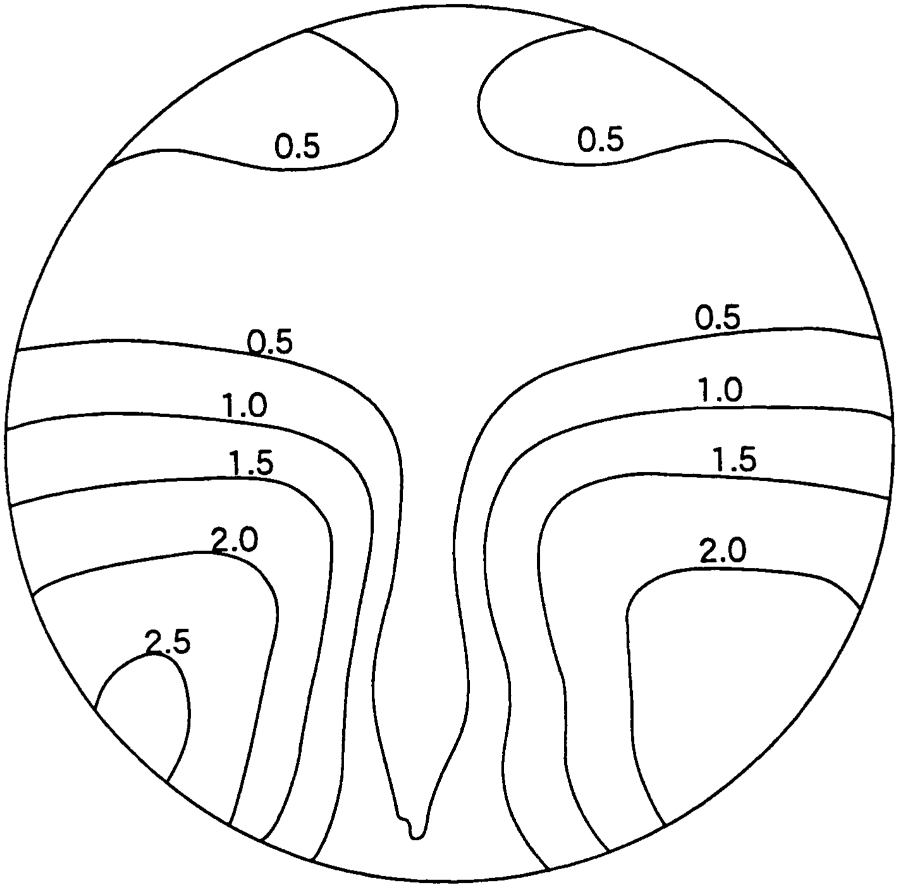
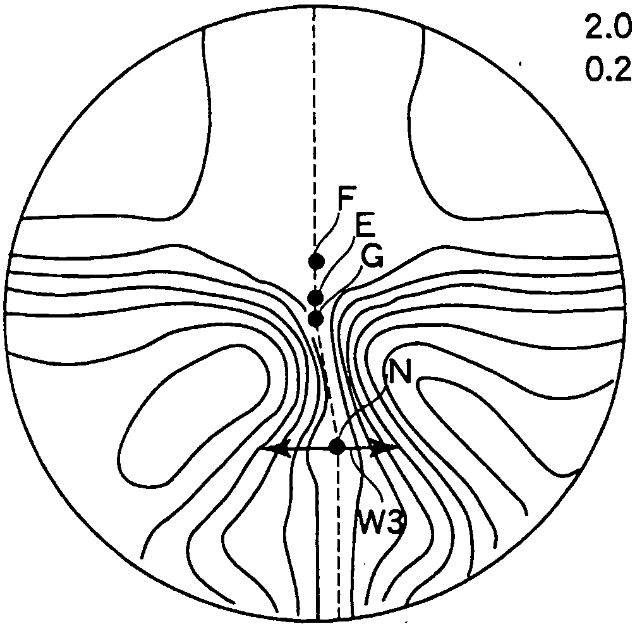
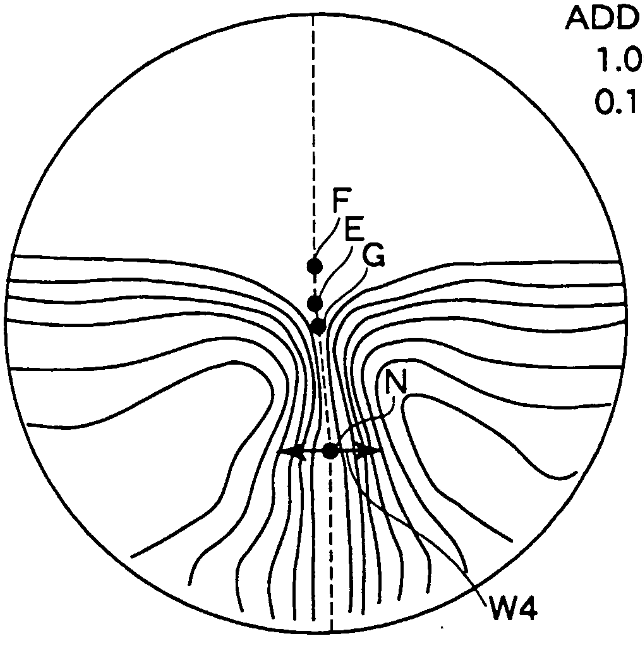


FIG.18



ADD
2.00
0.25 D PITCH

FIG.19



ADD
1.00
0.125 D PITCH

FIG.21

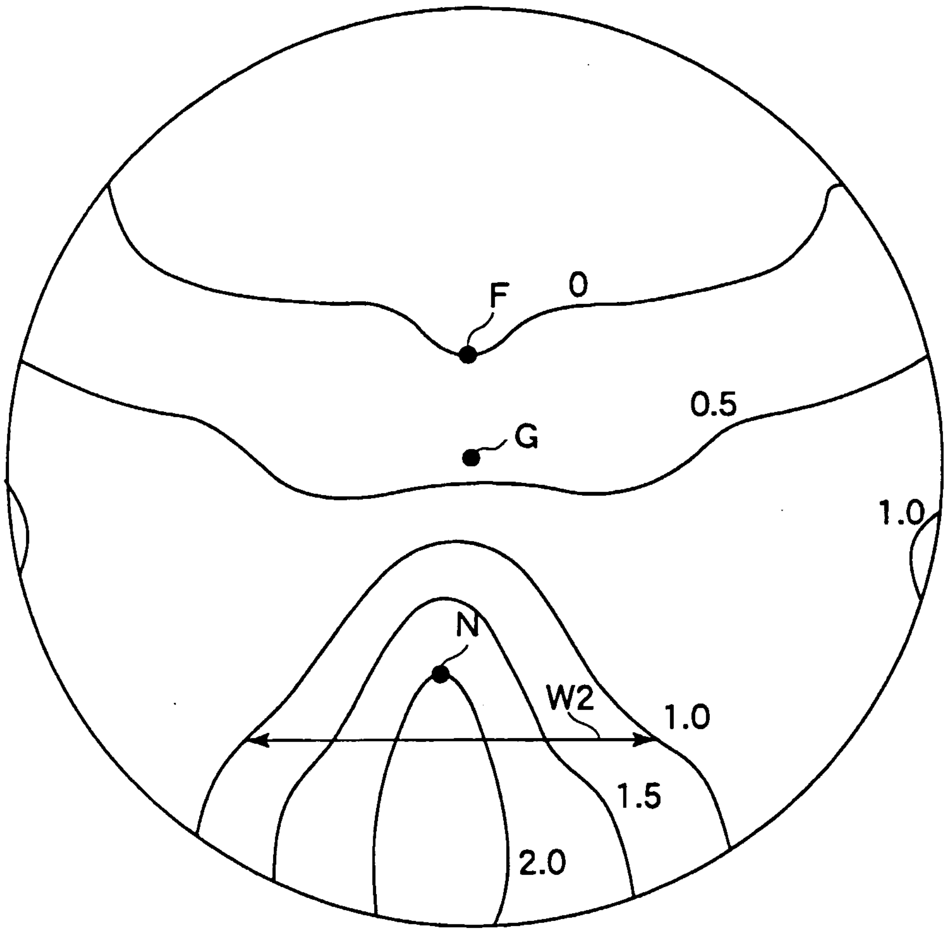


FIG.23

TENDENCIES OF SURFACE DISTRIBUTIONS RELATIVE TO TRANSMISSION DISTRIBUTIONS

FAR VISION POWER		ASTIGMATISM DISTRIBUTION	AVERAGE POWER DISTRIBUTION
+POWER +4. 50 (D)	DISTANCE PORTION	THE UPPER PART, THE MORE INCREASE	INCREASES SLIGHTLY THROUGHOUT PORTIN
	SIDE PORTION	INCREASES SOMEWHAT THROUGHOUT PORTION	DECREASES SLIGHTLY THROUGHOUT PORTION
	READING PORTION	LITTLE CHANGES	DECREASES THROUGHOUT PORTION
-POWER -5. 50 (D)	DISTANCE PORTION	INCREASES SOMEWHAT IN CENTRAL PART	DECREASES LARGELY IN CENTRAL PART
	SIDE PORTION	THE MORE SIDEWISE PART, THE MORE INCREASE	THE MORE SIDEWISE PART, THE MORE INCREASE
	READING PORTION	THE LOWER PART, THE MORE INCREASE	THE LOWER PART, THE MORE INCREASE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP96/02689

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 7-020410, A (Nikon Corp.), January 24, 1995 (24. 01. 95) & EP, 632307, A1	2, 3

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